1. A compact navigation system for a rover, the navigation system comprising:

a housing configured to be transported by the rover;

a gimbal system having two or more gimbals that includes at least an outer gimbal connected to said housing and an inner gimbal nested in and connected to said outer gimbal;

a solid state three-axis gyro assembly mounted on said inner gimbal;

a solid state three-axis accelerometer assembly mounted on said inner gimbal;

a gyro logic circuit responsive to said three-axis gyro assembly for producing an inertial angular rate about each gyro input axis;

an accelerometer logic circuit responsive to said three-axis accelerometer assembly for producing a non-gravitational acceleration along each accelerometer input axis; and

a processor responsive to said gyro logic circuit and said accelerometer logic circuit for determining the attitude and the position of said housing to provide for long term accuracy of the attitude and the position for navigation of the rover.

2. The compact navigation system of claim 1 in which the axis of said outer gimbal extends along the rover and has a substantially vertical orientation.

3. The compact navigation system of claim 1 in which the axis of said inner gimbal is oriented laterally in relation to the outer gimbal axis.

4. The compact navigation system of claim 1 in which said outer gimbal includes a drive motor for rotating said outer gimbal with complete rotary freedom.

5. The compact navigation system of claim 1 in which said inner gimbal includes a drive motor for rotating said inner gimbal.

6. The compact navigation system of claim 1 in which said inner gimbal is rotatable 180° in each direction.

7. The compact navigation system of claim 1 in which said inner gimbal includes a twist capsule device and said outer gimbal includes a slip ring or rotary transformer device for electrically interconnecting said gyro and said accelerometer logic circuits with said processor.

8. The compact navigation system of claim 1 in which at least one of the gimbals includes a gimbal angle readout.

9. The compact navigation system of claim 1 in which said solid state three-axis gyro assembly includes three, one-axis gyros.

10. The compact navigation system of claim 1 in which said solid state three-axis gyro assembly includes a MEMS gyro system.

11. The compact navigation system of claim 1 in which said solid state three-axis gyro assembly includes a laser gyro system.

12. The compact navigation system of claim 1 in which said solid state three-axis gyro assembly includes a quartz gyro system.

13. The compact navigation system of claim 1 in which said solid state three-axis accelerometer assembly includes three, one-axis accelerometers.

14. The compact navigation system of claim 1 in which said solid state three-axis accelerometer assembly includes a MEMS accelerometer system.

15. The compact navigation system of claim 1 in which said solid state three-axis accelerometer assembly includes a quartz accelerometer system.

16. The compact navigation system of claim 1 in which said gyro logic circuit includes a field programmable gate array.

17. The compact navigation system of claim 1 in which said gyro logic circuit includes an application-specific integrated circuit.

18. The compact navigation system of claim 1 in which said accelerometer logic circuit includes a field programmable gate array.

19. The compact navigation system of claim 1 in which said accelerometer logic circuit includes an application-specific integrated circuit.

20. The compact navigation system of claim 1 in which said processor commands rotation of said gimbals to determine north and vertical directions and to calibrate the gyro assembly and the accelerometer assembly biases.

21. The compact navigation system of claim 1 in which said processor commands rotation of said gimbals to determine north and vertical directions and to calibrate the gyro assembly and the accelerometer assembly biases and to calibrate gyro scale factors.

22. The compact navigation system of claim 1 in which said processor commands rotation of said gimbals to a plurality of positions to effect calibration of gyro and accelerometer model parameters.

23. The compact navigation system of claim 1 in which said processor commands carouseling and indexing of said gimbals to average out the inertial navigation errors due to gyro bias errors and inertial navigation errors due to accelerometer bias errors.

24. The compact navigation system of claim 1 in which said processor periodically commands the reversal of the carouseling and indexing of said gimbals to average out inertial navigation errors due to gyro scale factor errors and gyro misalignment errors.

25. The compact navigation system of claim 1 in which said processor also determines the velocity of said housing on the rover.

26. The compact navigation system of claim 1 in which said processor is coupled to an external aid that provides incomplete navigation visibility, the external aid being selected from the group consisting of an altimeter, a depth meter, a velocity indicator, a velocity log, a magnetic compass, a magnetometer, an odometer, terrain, a landmark, a map recognition, and a star sighting.

27. The compact navigation system of claim 1 in combination with a radio navigation system.

28. The compact navigation system and the radio navigation system of claim 27 in which said processor is responsive to information from said radio navigation system and uses the information as an external aid.

29. The compact navigation system and radio navigation system of claim 28 in which said processor uses only the navigation system to navigate when information from

the radio navigation system is not available.

30. The compact navigation system of claim 1 in which the rover is a land rover.

31. The compact navigation system of claim 1 in which the rover is a subterranean rover.

32. The compact navigation system of claim 1 in which the rover is a person.

33. A compact navigation system for a rover, the navigation system comprising:

a housing configured to be transported by the rover;

a gimbal system having three or more gimbals that includes at least an outer gimbal connected to said housing and an inner gimbal nested in and connected to one or more middle gimbals that are connected to said outer gimbal;

a solid state three-axis gyro assembly mounted on said inner gimbal;

a solid state three-axis accelerometer assembly mounted on said inner gimbal;

a gyro logic circuit responsive to said three-axis gyro assembly for producing an inertial angular rate about each gyro input axis;

an accelerometer logic circuit responsive to said three-axis accelerometer assembly for producing a non-gravitational acceleration along each accelerometer input axis; and

a processor responsive to said gyro logic circuit and said accelerometer logic circuit for determining the attitude and the position of said housing to provide for long term accuracy of the attitude and the position for navigation of the rover.

34. The compact navigation system of claim 33 in which the axis of said inner gimbal extends laterally in relation to the axis of said outer gimbal when the one or more middle gimbals are at a predetermined reference position.

35. The compact navigation system of claim 33 in which each of the outer gimbal, the one or more middle gimbals, and the inner gimbal includes a drive motor for

rotating the associated gimbal with complete rotary freedom.

36. The compact navigation system of claim 33 in which each of the outer gimbal, the one or more middle gimbals, and the inner gimbal includes a twist capsule device, a slip ring device, or a rotary transformer device for electrically interconnecting said gyro and said accelerometer logic circuits with said processor.

37. The compact navigation system of claim 33 in which the outer gimbal, the one or more middle gimbals, and the inner gimbal are equipped with gimbal angle readouts.

38. The compact navigation system of claim 33 in which said solid state three-axis gyro assembly includes three, one-axis gyros.

39. The compact navigation system of claim 33 in which said solid state three-axis gyro assembly includes a MEMS gyro system.

40. The compact navigation system of claim 33 in which said solid state three-axis gyro assembly includes a laser gyro system.

41. The compact navigation system of claim 33 in which said solid state three-axis gyro assembly includes a quartz gyro system.

42. The compact navigation system of claim 33 in which said solid state three-axis accelerometer assembly includes three, one-axis accelerometers.

43. The compact navigation system of claim 33 in which said solid state three-axis accelerometer assembly includes a MEMS accelerometer system.

44. The compact navigation system of claim 33 in which said solid state three-axis accelerometer assembly includes a quartz accelerometer system.

45. The compact navigation system of claim 33 in which said gyro logic circuit includes a field programmable gate array.

46. The compact navigation system of claim 33 in which said gyro logic circuit includes an application-specific integrated circuit.

47. The compact navigation system of claim 33 in which said accelerometer logic circuit includes a field programmable gate array.

48. The compact navigation system of claim 33 in which said accelerometer logic circuit includes an application-specific integrated circuit.

49. The compact navigation system of claim 33 in which said processor commands rotation of said gimbals to determine the north direction and the vertical

direction and to calibrate the gyro assembly and the accelerometer assembly biases.

50. The compact navigation system of claim 33 in which said processor commands rotation of said gimbals to determine the north direction and the vertical direction and to calibrate the gyro assembly and the accelerometer assembly biases and to calibrate gyro scale factors.

51. The compact navigation system of claim 33 in which said processor commands rotation of said gimbals to a plurality of positions to effect calibration of gyro and accelerometer model parameters.

52. The compact navigation system of claim 33 in which said processor commands carouseling or indexing of said gimbals to average out the inertial navigation errors due to gyro bias errors and inertial navigation errors due to accelerometer bias errors.

53. The compact navigation system of claim 33 in which said processor periodically commands the reversal of the carouseling or indexing of said gimbals to average out the inertial navigation errors due to gyro scale factor errors and gyro misalignment errors.

54. The compact navigation system of claim 33 in which said processor is coupled to an external aid that provides incomplete navigation visibility, the external aid being selected from the group consisting of an altimeter, a depth meter, a velocity

indicator, a velocity log, a magnetic compass, a magnetometer, an odometer, terrain, a landmark, a map recognition, and a star sighting.

55. The compact navigation system of claim 33 in combination with a radio navigation system.

56. The compact navigation system and the radio navigation system of claim 55 in which said processor is responsive to information from said radio navigation system and uses the information as an external aid.

57. The compact navigation system and radio navigation system of claim 56 in which said processor uses only the navigation system to navigate when information from the radio navigation system is not available.

58. The compact navigation system of claim 33 in which said processor also determines the velocity of said housing.

59. The compact navigation system of claim 33 in which the rover is a land rover.

60. The compact navigation system of claim 33 in which the rover is a subterranean rover.

61. The compact navigation system of claim 33 in which the rover is a person.

62. A method for navigating a rover on the Earth or other celestial body, the method comprising the steps of:

providing a housing configured to attach to the rover, the housing including a gimbal system having two or more gimbals that includes at least an outer gimbal connected to said housing, zero or one or more middle gimbals and an inner gimbal nested in and coupled one to the other and to said outer gimbal, said gimbal system including a solid state three-axis gyro assembly and a solid state three-axis accelerometer assembly mounted within said gimbal system;

obtaining information about a position of a first point in a trajectory of the rover;

if the rover is not initially stationary at the first point, obtaining information about the velocity and the attitude;

if the rover is stationary at the first point, determining the velocity due to rotation of the Earth or other celestial body from the position and determining the attitude of the first point in the trajectory of the rover using said three-axis gyro assembly and said three-axis accelerometer assembly by rotating said gimbal system through four or more gyrocompass positions;

traversing through the trajectory to a second point in the trajectory while inertially navigating and carouseling or indexing the gimbals;

if the rover is stationary at the second point, determining the attitude at the second point in the trajectory using said three-axis gyro assembly and said three-axis accelerometer assembly by rotating said gimbal system through four or more gyrocompass positions to obtain attitude results; and

updating navigation of the rover with the attitude results.

63. The method for navigating of claim 62, further including the step of calibrating gyro scale factors from the slews between gyrocompass positions.

64. The method for navigating of claim 62, further including the step of calibrating gyro and accelerometer system parameters from a plurality of gimbal positions when the rover is stationary on the Earth or other celestial body.

65. The method for navigating of claim 62, further including the step of updating the navigation with information from an external aid selected from the group of an altimeter, a depth meter, a velocity indicator, a velocity log, a magnetic compass, a magnetometer, an odometer, terrain, a landmark, a map recognition, a star sighting, a GPS and radio navigation information.

66. The method of navigating of claim 62 in which carouseling or indexing the gimbals is for averaging out inertial navigation errors due to gyro bias errors and inertial navigation errors due to accelerometer bias errors.

67. The method of navigating of claim 62, in which rotating said gimbal system through four or more gyrocompass positions is for determining gyro biases, accelerometer biases, and the components of the gravity vector and the rotation vector of the Earth or other celestial body.

68. The method of navigating of claim 62, further including the step of updating estimates of the level, azimuth, gyro bias, accelerometer bias and scale factor when the velocity of the rover is substantially zero.

69. The method of navigating of claim 68, further including the step of rotating the gimbals to discrete positions including up and down on each accelerometer, and 90 or 180 degrees about the level for determining the gyro bias and an error of the azimuth.

70. The method of navigating of claim 69, wherein the step of updating the estimates includes using a Kalman filter.